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A River Mussel Parasitic on a Salamander*

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It is commonly known that fresh water mussels (Unionidae) are parasitic in the larval stage on fishes. Owing to the great demand for pearl mussels particularly by the pearl button industry, the United States Bureau of Fisheries at one time undertook the rearing of mussels (Coker, Shira, Clark and Howard, 1921). In doing this a great deal of study was necessary to work out this parasitic relationship. It was found that certain of the desirable kinds of mussels required fishes of a certain species, genus or family, as the case might be. For instance, the yellow sand shell (*Lampsilis anodontoidea* Lea) was parasitic on the gars, and the niggerhead (*Fusconaia ebena* Lea) on the blue herring; lake mucket (*Lampsilis siliquioidea* Barnes) on the basses and perches; butterfly shell (*Plagiola lineolata* Rafinesque) on the sheepshead; warty-backs (*Quadrula pustulosa* Lea) on the channel catfish; Missouri niggerhead (*Obovaria olivaria* Rafinesque) on the sturgeons.

The glochidia will grow on their proper hosts. They will take hold on almost any fish that touches them in a manner to call forth their snapping reaction, but they will subsequently be shed or dropped off if not on an appropriate host.

Simpsoniconcha ambigua Say first came to our attention at Moline, Illinois, where we were investigating a problem with the United States Bureau of Fisheries. The washboard mussel, *Megalonaias gigantea* Barnes, an important shell to the button industry, was quite abundant there. To quote from our first account (Howard, 1915), "Nets placed near the mussel bed for the purpose of determining the host fishes of the washboard mussel yielded some material that presented quite another problem. With the fishes caught were a number of waterdogs, *Necturus maculosus* Rafinesque. From a total of fifteen caught, twelve were infected with glochidia of mussels. Upon attempt-

*Contribution from the Laboratories of the Allan Hancock Foundation, University of Southern California, Los Angeles.

ing to identify these, a few were found to be *Megalonaias gigantea*—not imbedded nor becoming so after an attachment for a known period of twenty-four hours or more. Evidently they were merely accidental infections upon an inappropriate host.

There was a great majority of infections caused by a glochidium then unknown. They were deeply imbedded in the external gills of the waterlog (Fig. 1); that is, the tissue of the gill had grown completely over them. By keeping the animals alive all winter we succeeded in carrying the glochidia through to the juvenile stage, these being shed the last week in May, soon after which we obtained the young mussels from the bottom of the aquarium in which the *Necturus* were held.

The parasitic period is a long one, over seven months from the date the infected salamanders were captured, October 17th to the last of May. We have observed some summer breeding mussels which made a comparable development in one week. The higher temperature at this season would explain the difference, for heat hastens the development. However, the carrying through of the parasite is the test of appropriateness of the host.

These glochidia were different from any in our station collection, of which we supposedly had a complete faunal set with one or two exceptions which we knew did not answer the case in question. We looked up all the known Unionidae which might have a range to the Mississippi River in western Illinois and found that one species was given which we did not have. This was *Simpsoniconcha ambigua* Say (Fig. 2). An inquiry at the Academy of Sciences, Davenport, Iowa, disclosed the fact that there was one record of collection for Davenport, Iowa. Baker (1898, p. 72) states that it is a small and characteristic species which is at once distinguished from other species found in this region [Illinois] by its fragile shell, delicate hinge armature and minute beak sculpture. Next to *Lampsilis parva* Barnes [*Carunculina parva*] it is the smallest species found in the region (less than two inches long). It lives "in rivers and creeks, under stones and other objects. It is also found in mud which is free from debris (Baker, *loc. cit.*). " The distribution is given as the "Great Lakes and Mississippi Valley."

Lea (1858, p. 49, pl. 5, fig. 31) figures the glochidium of this species, but it is so small and so like that of other species that without dimensions a certain identification could not be made from it. As the likelihood of finding material in some collection seemed slight, we decided to look for gravid mussels and make a direct comparison of the glochidia.

The female mussel when gravid carries the young in the outer gill, the gill thus acting as a marsupium. From the literature and from such information as could be gathered from experienced collectors, this species has the

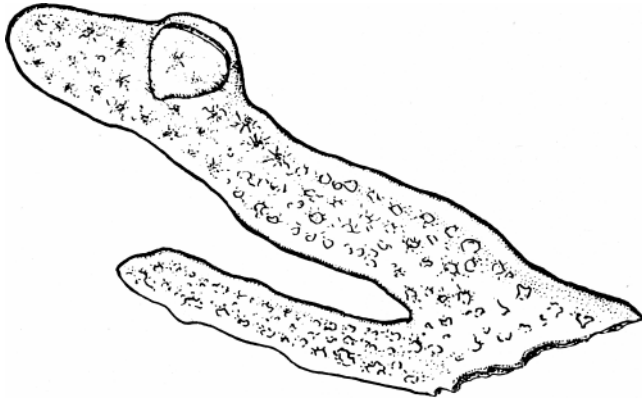


Figure 1. A branching filament of the gill of a waterdog, *Necturus maculosus*, with infection by the glochidia of the salamander mussel. Magnification 28 diameters.

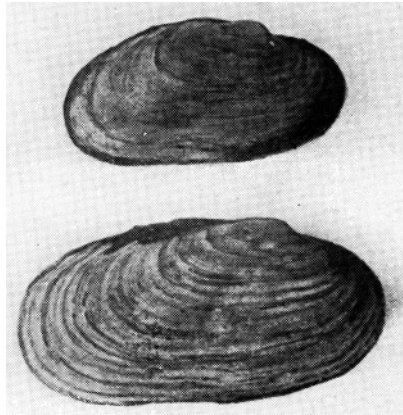


Figure 2. Two adult salamander mussels, *Simpsoniconcha ambigua*, the young of which are parasitic on the waterdog. Natural size. Photo by R. Rutherford.

peculiar habit of living under flat stones. This seemed to present a difficulty in collecting, for the water was deep at the point where the *Necturus* had been taken. We had dredged here considerably, but no examples of this species were in the hauls. Their habitat would seem to account for this failure to secure them as an ordinary boat dredge would be likely to miss them, protected as they are by the stone above. The best chance for success seemed to be to locate them in some small stream. Baker (*loc. cit.*) cites the collection of this species under such conditions. By correspondence with Mr. Baker we learned the names of the collectors who kindly gave us directions for finding locally the species which they had taken many years previously. The place they described was Hickory Creek, a branch of the Des Plaines River near Joliet, Illinois (Fig. 3).

The first five specimens found were not gravid; upon examination with a microscope all proved to be males. Returning again to the stream we found nine gravid mussels out of a total of seventeen. The first of these contained glochidia which corresponded exactly with the glochidia found on the *Necturus* in the Mississippi, thus giving us the link desired to make out the life history.

The glochidia are clear white in color, of the triangular type, with well-developed hooks (Fig. 4 a, b) contrary to the description given by Lea who suggested, however, the possibility of hooks in more mature specimens. The dimensions are as follows: height 0.265 to 0.274 mm., length 0.247 to .255 mm. All of the adult individuals were found under flat stones of the flagstone type characteristic of the limestone in the region. Beneath a single rock we found four.

While exploring the under surface of these we felt and seized a wriggling animal which proved to be a waterdog. The finding of the *Necturus* under rocks with gravid mussels suggests that the salamander may become inoculated in this way. Glochidia released by the mussels in such a location would not have a rapid dispersal by currents so that the waterdog commonly seeking such a shelter would run the chance of a heavy infection.

We suspect that *Necturus* eats the adult mussel and in seeking food visits one rock after another. In satisfying its appetite it becomes infected with the mussel glochidia, nourishing them, and when they have matured serves as a transporting and distributing agent for the young mussels.

Mussel-eating fish such as the sheephead (*Aplodinotus grunniens* Rafinesque) are known to be infected particularly by the thin-shelled species which they eat.

The finding of a mussel parasitic upon a salamander as the appropriate host instead of a fish was the first instance we have known to be recorded for an American mussel (Howard, 1915). Faussek (1901), in St. Petersburg,



Figure 3. Habitat of the salamander mussel. Hickory Creek, Joliet, Illinois. Photo by the author.

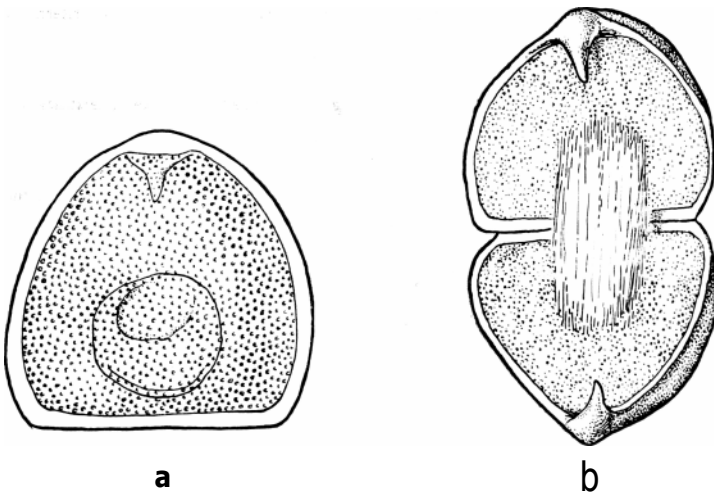


Figure 4. a, A closed glochidium of a salamander mussel as seen under the microscope magnified 160 diameters.

b, A glochidium open, in position to snap on to its host. Drawn by Anker Petersen.

experimented with Amphibia artificially infected with glochidia of *Anodonta*. He reported successful infection upon the larval form, axolotl, of the tiger salamander (*Ambystoma*) and the Austrian cave salamander (*Proteus*).

Seshaiya (1941), in India, reports finding tadpoles infected with glochidia.

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Natural History Miscellanea, a series of miscellaneous papers initiated in 1946 as an outlet for original articles, more or less technical in nature, one to four pages in length, in any field of natural history. Individual issues, published at irregular intervals, are numbered separately and represent only one field of specialization; e. g., botany, geology, entomology, herpetology, etc. The series is distributed to libraries and scientific organizations with which the Academy maintains exchanges. A title page and index will be supplied to these institutions when a sufficient number of pages to form a volume have been printed. Individual specialists with whom the museum or the various authors maintain exchanges receive those numbers dealing with their particular fields of interest. A reserve is set aside for future exchanges and a supply of each number is available for sale at a nominal price. Authors may obtain copies for their personal exchanges at the prevailing rates for similar reprints.

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